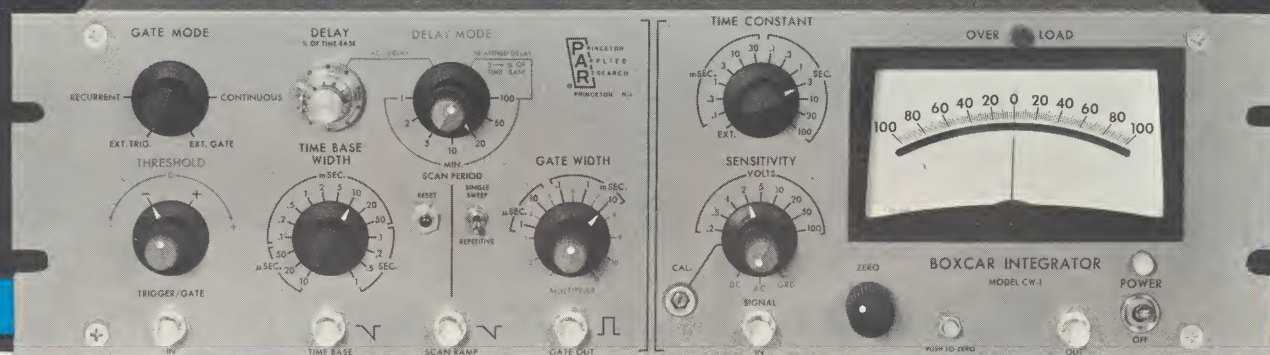


MODEL CW-1 BOXCAR INTEGRATOR



The Model CW-1 Boxcar Integrator is a gated signal averaging device useful for the recovery of either complete repetitive waveforms or incremental portions thereof from noise. The input to the Boxcar Integrator is sampled by a variable width, variable delay gate which can be fixed at any point on, or slowly scanned across, the repetitive waveform. The sampled portion of the input waveform is averaged by a variable time constant integrator, displayed on the panel meter, and made available for external recording or other use. Because the mean value of random noise is zero, the output of the integrator will asymptotically approach the average value of that portion of the input waveform being sampled at any moment, with a corresponding suppression of the accompanying noise. The Model CW-1 may be used in such widely varied applications as pulsed nuclear resonance, laser excitation decay, and biological evoked response experiments. In general, this instrument should be of value in any application where noise interferes with the recovery of repetitive waveforms.

SPECIFICATIONS

SIGNAL CHANNEL —

Input Sensitivity: ± 2 volt to ± 100 volts in 1, 2, 5, sequence for ± 10 volts output.

Dynamic Range: Will accept inputs 15 times full scale requirement without overloading.

Integration Time Constants: 100 microseconds to 100 seconds in 1, 3, 10 sequence.

Holding Time: At least 10^6 times integration time constant for 10% F.S. change in output, up to 10^5 sec.

Output: (a) $\frac{1}{2}\%$ Panel Meter, ± 10 volts.

(b) ± 10 volts provided at front panel at an impedance of 1 K.

(c) Recorder Output — suitable for most galvanometric and servo recorders.

GATE TIMING CIRCUITS —

Operating Modes: (a) Ext. Trigger

(b) Ext. Gate

(c) Recurrent: Time Base triggered automatically and repetitively.

(d) Continuous: Gate on continuously.

Time Base Widths: 10 microseconds to 1 second in 1, 2, 5 sequence.

Gate Pulse Width: Continuously adjustable from 1 microsecond to .11 second.

Delay: (a) Manual adjustment from 0% to 100% of Time Base Width.

(b) Automatic scanning from 0% to that % of Time Base Width selected by setting the Manual Delay Dial.

Automatic Delay Scan Periods: 1, 2, 5, 10, 20, 50, and 100 minutes.

GENERAL —

Power Requirements: 105-125 volts or 210-250 volts; 50-60 Hz; approximately 15 watts.

Size: 19"W x 5"H x 14"D.

Price: \$1,950.00. Export prices approximately 5 per cent higher (except Canada).



MODEL TDH-9

PAR Waveform Educator



The PAR WAVEFORM EDUCATOR extracts repetitive waveforms or transients from noise.

Experimental information in the form of repetitive waveforms can best be extracted from noisy signal channels by obtaining the cross-correlation function of the waveform-plus-noise with a train of delta-functions having the same repetition rate. The cross-correlation function will be the waveform of interest, noise having averaged to zero. Approximations of this operation may be performed digitally, but generally there are drawbacks in time efficiency, speed, and expense. The PAR TDH-9 WAVEFORM EDUCATOR is an analog averaging instrument having one hundred channels of capacitor memory. The cross-correlation approximation is obtained by dividing that part of the input waveform of interest into one hundred segments. These are switched sequentially and synchronously through a resistor to the memory capacitors where the average is obtained and stored. The information in the memory bank is continuously observable on a monitor scope and the average can finally be photographed or read out on an X-Y or strip-chart recorder. The TDH-9 has the advantages of speed, efficiency, and low price.

SPECIFICATIONS

Resolution: 100 channels. Output smoothing provides continuous output waveform rather than "stairstep."

Sweep Duration: Continuously adjustable from 100 μ S to 11 Sec in five ranges. (Dwell time/channel: 1 μ S to 110 mS.)

Characteristic Time Constants: 5 Sec to 100 Sec in 1-2-5 sequence. The characteristic time constant is that time constant with which the output waveform responds to changes in the input waveform: Because the stored waveform is held during the time between sweeps, the observed time constant can be larger than the setting of the Characteristic Time Constant Switch.

Sweep Delay: A delay of 10 μ S to 11 Sec can be inserted between receipt of trigger pulse and initiation of sweep.

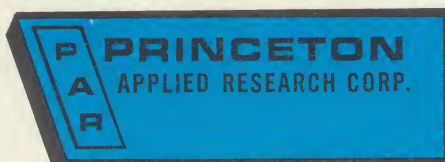
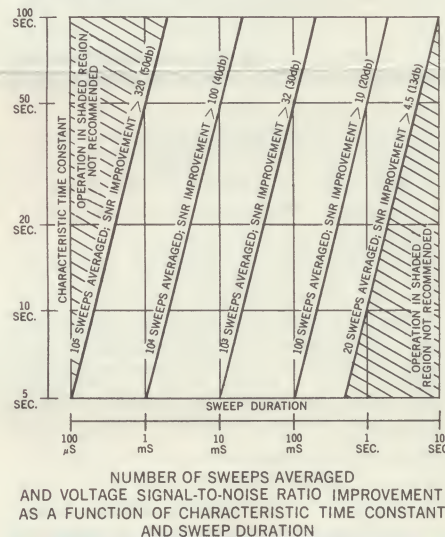
Output: Full scale is ± 10 volts, capable of driving oscilloscopes, X-Y recorders, and strip chart recorders. Readout can be as slow as 100 Sec (dwell time/channel 1 Sec).

Dynamic Range: Noise and interference five times the full-scale input will not cause overload. Output noise

with shorted input for most combinations of Sweep Duration and Characteristic Time Constant is below 0.2% of full scale.

Power: 105-125 or 210-250 volts AC, 50-60 Hz; 25 watts.

Price: \$4200.00



NEW LOCK-IN from PAR

The PAR Model HR-8

represents a significant achievement in extending the line of lock-in amplifiers manufactured by Princeton Applied Research Corporation, pioneers in the manufacture of low level signal recovery equipment for experimentalists. PAR physicists and engineers have produced in this instrument the finest and most versatile lock-in amplifier available. Conservative design techniques are employed throughout to optimize and insure high reliability. The operational features incorporated in this instrument reflect the best efforts of individuals whose experience in the design and application of lock-in amplifiers to small effect physical phenomena is unexcelled in the field.

The PAR Model HR-8 Lock-In Amplifier represents a significant advance in signal processing equipment for experimentalists who must measure low-level signal intensities in the presence of noise. It employs the theoretically optimum technique for signal recovery, and can be incorporated into a large class of experiments in which the signal of interest is, or can be made periodic, and in which a reference voltage related in frequency and phase to the signal can be obtained. The Model HR-8 first amplifies and bandlimits the input signal and then crosscorrelates it with the reference signal, suitably phase shifted and shaped. The crosscorrelation of input and reference signals yields a DC output voltage proportional to the signal of interest, while the crosscorrelation of the reference and noise results in no net DC voltage. The system can also be described as a continuously integrating, highly sensitive, phase conscious voltmeter, the response of which is "locked" to that particular frequency and phase at which the signal information has been made to appear.

Technical Features:

Frequency Range: 1.5 cps to 150 KC continuously tunable in 5 ranges.

Time Constants: 11 values in 1-3 seconds extending from 0.001 to 100 seconds. Single or double section RC filtering.

Sensitivity: 21 calibrated full scale ranges in 1-2-5 sequence.

With Type A Pre-Amplifier: 100 nanovolts to 500 millivolts rms.

With Type B Pre-Amplifier: 1 nanovolt to 5 millivolts rms.

With Type C Pre-Amplifier: 10 nanovolts to 50 millivolts rms.

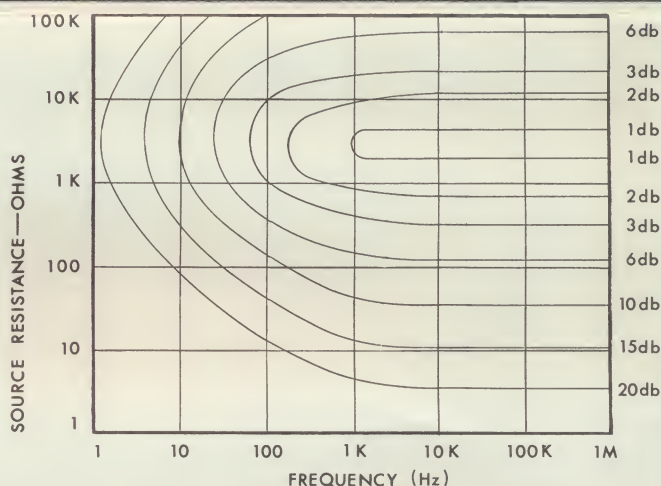
Output: ± 10 volts full scale, single-

ended with respect to ground. Will drive galvanometric and servo recorders.

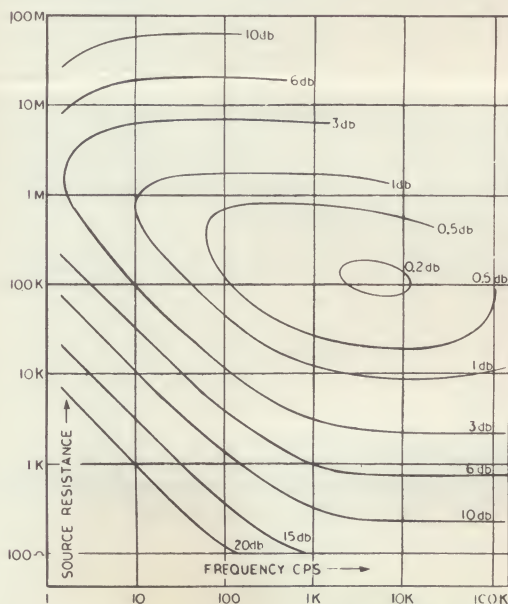
Frequency Selective Amplifiers: Notch network in negative feedback loop used in both signal and reference channel tuned amplifiers. Reference channel Q of 10. Signal channel Q adjustable from 5 to 25 with calibrated dial (no gain change with Q adjustment).

Phase Adjustment: Calibrated 360° phase shifter, providing continuous rotation as well as a four position quadrant switch which shifts phase in 90° increments.

Linearity and Drift: Linearity better than $\pm 0.1\%$ full scale. Zero drift less than $\pm 0.1\%$ full scale in 24 hours.



TYPICAL NOISE FIGURE CONTOURS FOR HR-8 WITH TYPE C PREAMPLIFIER



Contours of constant noise figure for a typical PAR Type A preamplifier plotted to show dependence on frequency and source resistance at 300° K. Amplifier operated single-ended.

Zero Suppress: Calibrated control permits offsetting zero by $\pm 1000\%$ of full scale on any range.

Monitor: A five position switch allows the panel meter and monitor output terminals to be switched to critical points in the circuit. When switched to the signal position the instrument serves as a tuned voltmeter (not phase sensitive) with sensitivity equal to one hundredth of the coherent-signal sensitivity.

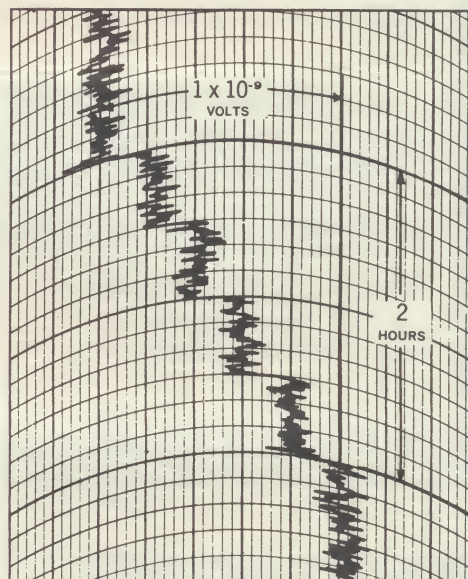
Internal Calibrator: Twenty-one calibrated levels from 20 nanovolts to 100 millivolts. Accuracy 1%.

Power: 105 — 125 or 210 — 250 volts AC; 50 — 60 CPS; 25 watts.

PRICE:

HR-8	\$1,950.00
Requires one of the following interchangeable plug-in preamplifiers.	
Type A Pre-Amplifier	\$300.00
High impedance.	
Type B Pre-Amplifier	\$300.00
Low impedance, low frequency.	
Type B-1 Pre-Amplifier	\$350.00
Low impedance, high frequency.	
Type C Pre-Amplifier	\$400.00
Medium impedance.	
Remote Pre-Amp Kit	\$80.00
To allow use of plug-in pre-amp at remote location.	

Availability: Within 30 days.

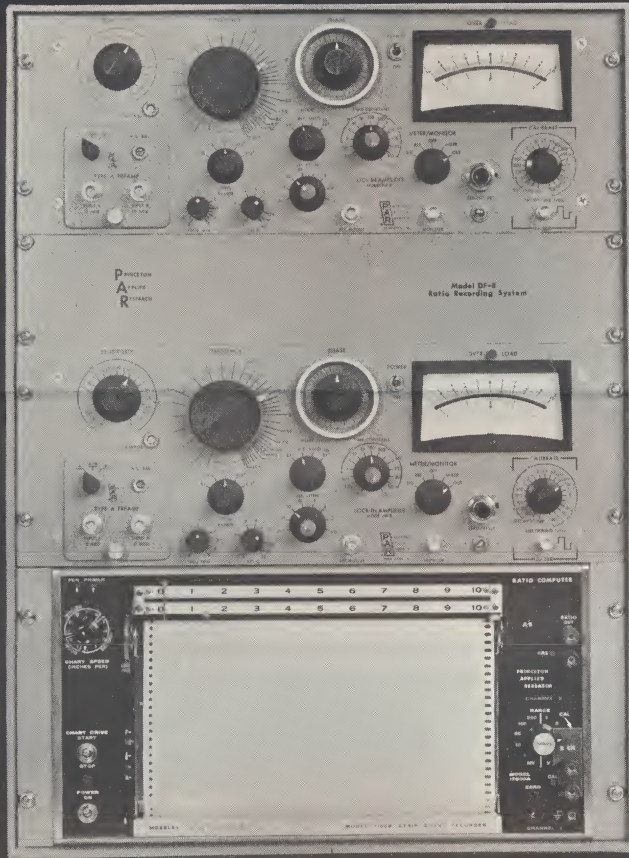


Strip chart recording showing 100 CPS signal from 10 ohm source at 300° K using Model HR-8 Lock-In Amplifier with Type B pre-amp. Integrating time constant of 30 sec; single section filter (6 db/octave). Each of the five steps is 2×10^{-10} volts and is of 30 minutes duration. Measured noise figure, 2.4 db.

Ratio Recording System

from

Princeton Applied Research



The Model DF-8 Ratio Recording System combines two precision Model HR-8 Lock-In Amplifiers and a high-quality, dual channel recorder into an integrated system capable of recovering two extremely low level signals from noise and monitoring their ratio. Relative measurements of such characteristics as transmission, absorption, reflectivity, fluorescence and luminescence, as well as characteristic response curves can be readily accommodated by the Model DF-8 Ratio Recording System.

Additional flexibility is inherent in this system, since either one or both of the Precision Model HR-8 Lock-In Amplifiers, as well as the recorder, can be used independently in a wide variety of experimental situations.

RATIO RECORDER

The dual channel, fast response recorder used in the Model DF-8 Ratio Recording System is a standard laboratory instrument featuring high accuracy and a wide range of chart speeds. Its operation in the ratio

mode has been accomplished by the addition of special circuitry that allows critically damped response over a dynamic range as wide as 100:1. A 0-1 volt DC signal proportional to the measured ratio is also available for digital voltmeter monitoring or other uses. One channel of the recorder can be used without modification as a standard linear strip chart recorder when the ratio mode is not required.

SPECIFICATIONS

Input Voltage Levels: (A and B Channels)

Depends upon sensitivity settings of model HR-8.

Ratio Range: A/B: 0.0 to 1.0, B range 0.1 to 10 V.

Accuracy: .25 per cent full scale.

Chart Speeds: 12 selectable speeds: 1, 2 in/hr; .1, .2, .5, 1, 2, in/min; .1, .2, .5, 1, 2, in/sec.

Response: 0.5 sec. full scale.

Output: 0 - 1 V DC output proportional to recorded ratio of 0.0 - 1.0 is available to drive digital voltmeters or other external circuitry.

Size: (System) 26½" H x 18" D x 19¾" W. Rack Cabinet.

Weight: Approximately 100 pounds.

Price: \$7,500.00

Warranty: One year.



For additional information write or call COLLECT

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